

Application of the Polyvinylchloride Pipe as a Splint for Comminuted Fracture of the Proximal Phalanx (P1) in a Pony

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ABSTRACT

A 9-month old crossbred, 165 kg, male painted pony was presented with severe lameness, pain, and swelling of the proximal phalanx (P1) of the right forelimb. A history taking revealed an accidental slip on the pasture while it was running. Radiographic examination revealed severely comminuted fracture of the proximal phalanx (P1). External coaptation was performed as fracture stabilization method. The pony was anesthetized and subsequently the $\frac{3}{4}$ limb supporting Robert Jones bandage (RBJ) was applied with external support from a polyvinylchloride (PVC) pipe. The inner layer of RBJ was changed forthnightly but the PVC pipe was used until the fracture healed. An optimum fracture healing and a good return to function were achieved within a period of 7 months. However an athletic function may not possible be regained. The advantage of using the PVC pipe is a lower cost of treatment compared to other commercial fiberglass cast. The effectiveness of using the PVC pipe in this report supports the idea of using this material for treatment of severely comminuted P1 fracture in young pony.

Key words: proximal phalanx, comminuted fracture, polyvinylchloride pipe, splint

INTRODUCTION

Comminuted fracture of the proximal phalanx (P1) can cause acute, non-weight bearing lameness. This condition usually results in limb deformity of equine patients. The comminuted fracture of P1 may occur during racing or as pasture accident injury (Richardson, 1999). Theoretically, the comminuted fracture of P1 may be defined as several fracture lines with three or more major segments of bone (Denny, 1989, Kraus *et al.*, 2004). Two types of P1 comminuted fracture, moderate and severe, are defined in equine species (Kraus *et al.*, 2004). The moderate comminuted

P1 fracture is the fracture having one fragment that extended the length of the bone (intact cortex) which is possible to be reconstructed with internal fixation. In contrast, the fracture that have no intact length of cortex and all fragments of bone could not be reconstructed is characterized as severely comminuted P1 fracture (Kraus *et al.*, 2004). At least two radiographic views, dorsopalmar and lateromedial, are needed for accurate diagnosis (Denny, 1989).

Principally equine fracture treatment methods can be divided into conservative and surgical methods (Auer, 1999). Conservative treatment can be stall rest, external coaptation, for

instance splints or casts. The surgical treatment can be external fixation using transfixation or external fixator device (Auer, 1999, Joyce *et al.*, 2006). The common complications from all methods are: bone infection, nonunion, contralateral limb injury due to weight shifting. Euthanasia may be required in some cases. Generally, the P1 fracture of an equine is always severely comminuted type making it a good candidate to be treated with external coaptation, for instance, a cast with transfixation pin or with an external skeletal fixation apparatus (Richardson, 1999). However aforementioned techniques and materials are expensive for horse owners.

Appropriate limb stabilization, such as, Robert Jones bandage (RJB), is needed at the beginning (Campbell, 1996) followed by, the external coaptation that applies to stabilize the fracture and to partially support the weight bearing of the affected limb (Smith, 2006). The moderately comminuted P1 fracture may require only lag screw technique or in combination with dynamic compression plate to reconstruct the bone fragment (Kraus *et al.*, 2004). One example of the external coaptation is walking cast technique being considered as the treatment option of severely comminuted P1 fracture (Denny, 1989).

The purpose of this article was to report an outcome from the technique using external coaptation by applying polyvinylchloride (PVC) pipe and cap as a splint to stabilize a severely comminuted P1 fracture in a young pony.

MATERIALS AND METHODS

History and physical examination

A nine-month crossbred painted pony, weighing 165 kg, was presented to the equine clinic, Kasetsart University Veterinary Teaching Hospital at Kamphaengsaen with severe lameness (grade 4 or 5), signs of pain and swelling of the proximal phalanx (P1) of the right forelimb. There

was no opened wound at fracture site. From history taking, the pony had a pasture accident (slip and fall accident) five days before and had shown sudden lameness. Previous treatments were nonsteroidal anti-inflammatory drug administration and temporary external coaptation made from several wood sticks to provide stabilization of the lower limb (fetlock to hoof). At the equine clinic, general physical examination and orthopedic examination were performed. The degree of lameness was still within an acceptable limit for treatment.

Radiographic examination

The radiography of the distal right forelimb was performed in lateromedial and dorsopalmar views. From the radiographic images, the pony had severely P1 comminuted fracture demonstrated without an intact strut. A lack of inherent stability of bones and soft tissue swelling of the fetlock and pastern area were detected (Figure 1 A, B).

External coaptation

No opened wound was detected at the fracture site. Since there was no intact length of cortex, the reconstruction of bone fragments was not possible. Therefore non-surgical method using external coaptation was chosen. Due to financial constraint and non-athletic career of the horse, an alternative material was selected to replace an expensive fiberglass cast to minimize the cost of the treatment. The polyvinylchloride (PVC) pipe was selected as an alternative splint. The PVC pipe can be divided in a half splint and use as one or two plastic gutter splint covering around RJB bandage at the fracture area, depending on the anatomy and treatment purposes (Campbell, 1996). Since the pony was still young and had light weight as well as small sized leg, we decided to use total PVC pipe as a splint and cover the bottom PVC hole with PVC cap. The pony was sedated with Xylazine hydrochloride (1.1 mg/kg body

weight) and anesthetized with ketamine hydrochloride (2.2 mg/kg body weight). The duration of anesthetic drug was long enough (about 30 min) for the external coaptation procedure. The heel of the affected limb must be adjusted to an elevating position and interphalangeal joints have to flex in order to make P1 and third metacarpal bone in the longitudinal alignment (Richardson, 1999). Subsequently, the standard Robert Jones bandage (RBJ) was applied for 3/4 of total limb length and was supported with large amount of cotton wool (1.5 times thicker than that from distal third) in upper one third of the bandage. Then the polyvinylchloride (PVC) pipe (diameter about 10.5 cm.) was applied to cover the limb from hoof to mid radius level. An elastic tape was placed around the proximal end of PVC pipe and skin and the distal end of the pipe was closed with PVC cap. The RBJ was changed forthnightly as it could have become loosen, but the PVC pipe was used until the fracture healed. The pain-killer, phenylbutazone (2.2 mg /kg body weight, orally, BID) was given to the pony for three weeks. The pony was confined in box stall before sending back to pasture for four weeks. This technique was performed for seven months and the radiographic

images were evaluated afterwards.

RESULTS

The complete, transarticular fracture of P1 with overriding pieces was detected in radiography (Figure 1 A, B). A severely comminuted fracture of P1 was diagnosed. Periarticular soft tissue swelling indicated soft tissue injuries around the fetlock joint (e.g. joint capsule, tendons and ligaments).

Treatment with PVC pipe coaptation yielded optimal healing with a good consolidation of the callus across the fracture line after 7-month coaptation (Figure 2 A, B). Since the foal was young, the proximal phalanx remodeled and developed closely to the normal axis. Telephone follow up was used to assess the outcome of treatment. A successful outcome was given to the pony in which the fractures healed and, if planned, was able to use for breeding. Two years after the removal of the PVC pipe the owner reported that the pony had enlarge fetlock but walked comfortably on the pasture and had been prepared for breeding purpose.

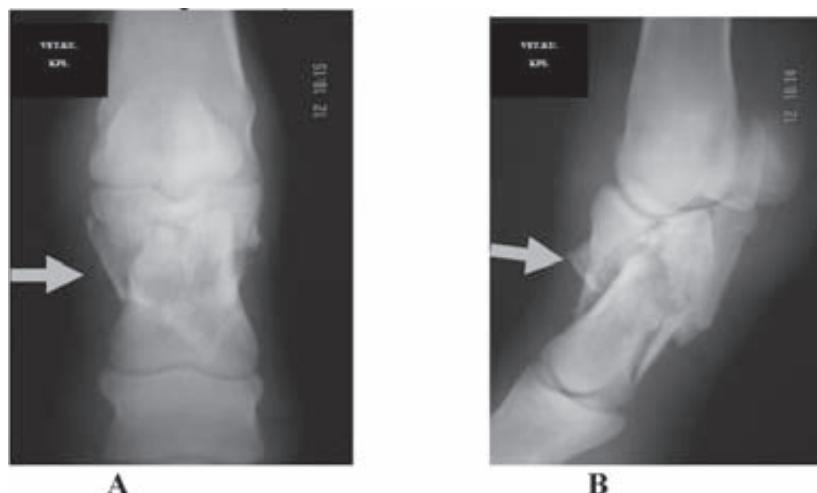


Figure 1 Showing the radiographic images of severely comminuted P1 fracture both dorsopalmar (A) and lateromedial (B) views (before using PVC as external coaptation device).

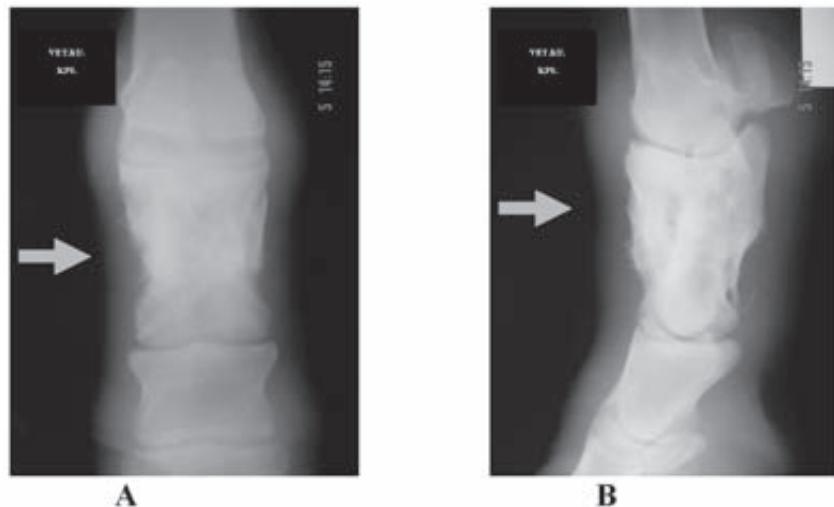


Figure 2 Showing the radiographic images of healing comminuted P1 fracture (after 7- month PVC – external coaptation) both dorsopalmar (A) and lateromedial (B) views.

DISCUSSION

Generally, fetlock joint effusion and pain due to the P1 fracture are always found by the veterinarian. In this case, slip and fall accident, the bony column of P1 could receive enormous load from movement of body. The sagittal ridge of third metacarpal bone acts as a pile driver upon loading causing the P1 broken and displaced in the direction of sagittal, frontal and transverse plane. If P1 fracture occurs in a race horse, the trotting after diagnostic anesthesia should not be done since the complete bone fracture may happen. The comminuted P1 fracture of this pony was not a candidate for the surgical treatment because none of the intact strut of bone was found. If an intact medial strut of bone was presented, the lag-screw reconstruction could be done (Denny, 1989; Richardson, 1999).

Generally, the treatment option for severe P1 fracture is aimed to use transfixation casting or external fixator for salvage. One example of the external coaptation is walking cast technique considered as a treatment option of P1 comminuted fracture (Denny, 1989) otherwise, the treatment with a simple external coaptation such as fiberglass

cast, is recommended. Fiberglass cast can be collapsed or cracked causing moister to be distributed inside the cast and probably causes infection at the fracture area. However, we decided to use polyvinylchloride (PVC) pipe and cap as the coaptation device. During applying RBJ bandage, elevation of the affected heel and flexion of the interphalangeal joints were performed to prevent the tendons and ligaments on the palmar aspect to be subjected to more injury. A compression RBJ was applied on the affected limb to stabilize the bone fragments at certain degree and to reduce soft tissue swelling.

In walking cast technique, the weight of the limb was transmitted from the pin through steel frame attached to the hoof (Denny, 1989). Half limb cast also reduced transferring of weight-bearing load to the distal part of the limb (Schneider *et al.*, 1998). Since the upper one third of PVC pipe was well fitted to the RBJ bandage by extra thickness of cotton wool, the weight of P1 fracture limb was probably diverted to the PVC pipe splint covering the affected limb.

The development of enormous callus at P1 fracture could cause P1 shortening, partial ankylosis of the fetlock, osteoarthritis resulting in

lameness (Denny, 1989). The normal contralateral limb had to bear more weight and could develop laminitis or tendinitis of the deep digital flexure tendon (Denny, 1989). However, there was no complication of contra-lateral limb. This was probably due to the pony body weight being diverted to the PVC pipe and cap. In addition, the pony was young and had light body weight, thus helping successful fracture healing.

CONCLUSION

The PVC pipe as splint combining with the RBJ bandage for external coaptation provided optimal fracture healing for severely comminuted P1 fracture in a pony. The advantages of PVC pipe are cheap, strong and easy to find as well as water resistant. The result from this report suggests that PVC pipe and cap could be an alternative external coaptation device for equine veterinarians in practice, especially for fracture stabilization of young ponies.

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